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RIGINAL

Ceratocystis fagacearum in Living and Dead Texas Live Oaks

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SUMMARY

Ceratocystis fagacearum colonized Texas live oaks (*Quercus virginiana* var. *fusiformis*) to a depth of 10 annual increments in sapwood, either before or shortly after initial symptom expression. The fungus survived in dead wood up to 12 months after oak wilt caused crown mortality. Both moist wood at the root collar level and dry wood at the d.b.h. level support *C. fagacearum* survival. The fungus was isolated from dead wood in March, June, September, and October in 2.5 percent of the 3,600 isolation samples used in the study.

INTRODUCTION

Epiphytotic levels of oak wilt (*Ceratocystic fagacearum*) have been reported in central Texas (Appel and Maggio 1984). Texas live oak (*Quercus virginiana* var. *fusiformis*) is the principal species affected, but other species are also susceptible. Research has been focused on epidemiology and disease control in recent years. A preliminary report on disease management is currently being used to help combat the problem in Texas (Lewis and others 1983). Additional information on fungal survival would enhance the value of the preliminary report and strengthen recommendations for sanitation procedures and precautions. The information in this report provides new data on *C. fagacearum* colonization and survival in living and dead Texas live oaks in central Texas. Information on *C. fagacearum* survival in trees killed by oak wilt is needed to minimize new incidences of the disease that could be caused by transporting fuel wood from oak wilt infested areas to noninfested areas.

MATERIALS AND METHODS

Isolations were made from 13 annual layers of sapwood and heartwood from 5 living trees in Kerrville, TX, infected with oak wilt; these trees all exhibited typical oak wilt symptoms. Isolations were made in April, June, July, and September. Successive 2-year increments of sapwood were excised from cross-sectional, lower trunk disks (0.3 to 1.0 m above soil level), disinfected in 1.05 percent (a.i.) sodium hypochlorite for 30 to 90 seconds, and plated on potato dextrose agar (PDA) in petri dishes. *Ceratocystis fagacearum* was identified when it grew from the wood chips at 22 to 26 °C. From 20 to 60 isolation samples were taken from each layer of sapwood in each tree. The percent of samples with *C. fagacearum* was calculated for each layer of sapwood.

Survival of *C. fagacearum* in dead Texas live oak wood 6 to 12 months after crown mortality was evaluated from 1984 to 1986 in Kerrville, TX. Twenty-four trees, all dead to the root collar, were sampled in March, May, June, September, and October. Oak wilt had been confirmed in each tree up to 2 years earlier. The roots were still alive in each sampled tree, but the trunk section 60 cm above the soil line was dead and completely dried out. Isolations were made from root collar zones (most were dead but had high moisture content) and trunk sections at 1.3 m above the soil line (d.b.h.). Trunk sections (about 60 cm long) were cut from each tree and stored at 5 °C until used for isolations. Isolations were made from three depth intervals (0-1 cm, 1-2 cm, and 2-3 cm) from cross-sectional disks of each section of wood. Twenty-five isolation samples were taken from each depth of each disk and disinfected in sodium

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hypochlorite (1.05 percent a.i.) before plating them on PDA. The number of samples with *C. fagacearum* isolations was tabulated.

RESULTS AND DISCUSSION

Lower bolewood of symptomatic and recently infected trees was extensively colonized by *C. fagacearum* in spring, summer, and autumn. The fungus was isolated from sapwood formed 10 years earlier. The highest rate of recovery was from sapwood that was formed 1 to 2, 3 to 4, and 5 to 6 years prior to isolation (fig. 1). *Ceratocystis fagacearum* was isolated from about 20 percent of these samples. The fungus was not isolated from heartwood or from samples of 11- to 13-year-old wood.

Ceratocystis fagacearum was isolated from 9 of 24 Texas live oaks 6 to 12 months after total crown mortality. The fungus was isolated from samples taken in March, June, September, and October, but not in samples taken in May. It was recovered from 1.7 to 6.9 percent of the isolation samples during these months (table 1). Only 2.5 percent of the 3,600 isolation samples yielded the fungus.

The highest rate of *C. fagacearum* isolation was 6 percent at the 1 to 2 cm depth of root collar sections (table 2). The 2- to 3-cm depth of root collar sections gave the second highest recovery rate and the 1- to 2-cm depth of d.b.h. sections gave the lowest. *Ceratocystis fagacearum* was isolated from 3.5 percent of the 1,800 samples at the root collar zone, but only 1.4 percent of the 1,800 samples from the d.b.h. levels in the same 24 trees. *Ceratocystis fagacearum* remained viable in Texas live oak trunks up to 12 months after total crown mortality but at relatively low levels.

Table 1.—Ceratocystis fagacearum *isolations from Texas live oak* (Quercus virginiana *var.* fusiformis) *bolewood 6 to 12 months after crown mortality in 1984 to 1986 due to oak wilt at Kerrville, TX*

Month of isolation	Trees sampled	Trees with *C. fagacearum*	Isolation samples	*C. fagacearum* isolations
		Number		*Percent*
March	6	2	900	2.7
May	6	0	900	0
June	3	2	450	4.2
September	6	3	900	1.7
October	3	2	450	6.9

Table 2.—Ceratocystis fagacearum *isolations from various depths of Texas live oak* (Quercus virginiana *var.* fusiformis) *bolewood at root collar and d.b.h. levels 6 to 12 months after crown mortality due to oak wilt at Kerrville, TX*

Sample location and depth	Isolation samples	*C. fagacearum* isolations
	Number	*Percent*
Root collar		
0–1 cm	600	1.8
1–2 cm	600	6.0
2–3 cm	600	2.7
D.b.h.		
0–1 cm	600	2.0
1–2 cm	600	1.0
2–3 cm	600	1.2

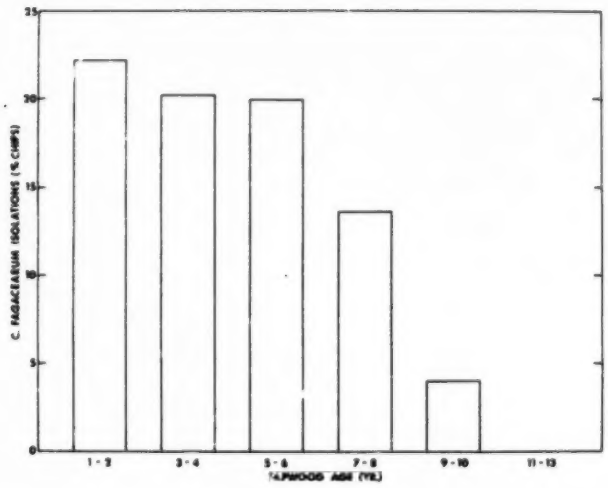

Figure 1.—*Frequency of* Ceratocystis fagacearum *isolations from 1- to 13-year-old sapwood of* Quercus *spp. with initial oak wilt symptoms in Kerrville, TX.*

Deep colonization by *C. fagacearum* makes chemical treatments with systemic fungicides less likely to succeed because more host tissue would have to be penetrated by effective levels of the chemicals. Also, deep colonization probably aids fungus survival during hot summer months. Sapwood temperatures are much lower than ambient temperatures during the summer in Texas (Lewis 1985).

Survival of *C. fagacearum* for 12 months in dead Texas live oaks is contrary to what one might expect. In Arkansas, *Hypoxylon* spp. deplete carbohydrates in oak wilt killed trees and inhibit *C. fagacearum* survival (Tainter and Gubler 1973). Carbohydrate depletion by *Hypoxylon* spp. was not found in Texas live oaks affected by oak wilt (Tainter and Lewis 1982). This might

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help explain why *C. fagacearum* was recovered from trees after crown mortality.

Ceratocystis fagacearum was isolated from twice as many root collar level samples than those from the d.b.h. level. This difference may be explained by a more favorable xylem temperature and moisture content at the root collar level. Root collar temperatures are lower than d.b.h. temperatures in Texas live oaks (Lewis 1985). Moisture content was relatively high at the root collar zone, but low at the d.b.h. level and a reduction in moisture content of oak wood adversely affects *C. fagacearum* survival (Tainter and others 1984).

The recommendation not to transport firewood from trees killed by wilt to areas where there is no oak wilt (Lewis and others 1983) is reemphasized as a result of this study. Infected wood should be utilized at or near the site of origination.

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